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ABUNDANCE OF ECTOMYCORRHIZAE ON RED PINE IN MICHIGAN STATE NURSERIES IN 1976

by

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INTRODUCTION

Studies on the ectomycorrhizae of red pine have shown that they increase the surface area of the roots, increase root longevity, aid in absorbing soil-bound nutrients, increase tolerance to stress, with a resulting increase in seedling survival. Ectomycorrhizae have also been shown to provide protection against certain soil pathogens.

In view of the obvious benefits of ectomycorrhizal fungi, one-, two- and three-year-old red pine seedlings from the Southern Michigan and the Wyman State Nurseries in Michigan were examined to determine if the development of ectomycorrhizae was adequate. Ectomycorrhizae on red pine roots is judged adequate when at least 80% of the feeder roots are infected.

OBJECTIVE

To determine the presence of, and evaluate the development of ectomycorrhizae on one-, two- and three-year-old red pine at the two Michigan State Nurseries, and to determine if a relationship existed between ectomycorrhizae and soil fertility factors.

METHODS

The percentage of ectomycorrhizal feeder roots on each age class was determined by:

(1) Selecting 80 seedlings at random from two beds of each age class at each nursery.
(2) Classifying all of the feeder roots as ectomycorrhizal and nonectomycorrhizal on the 1- and 2-year-old seedlings.[1/]
(3) Examining the 3-year-old seedlings by selecting a stratified 10 percent sample from the root system on each seedling.[1/]
(4) Forty cataloged mycorrhizal and nonmycorrhizal roots were microscopically examined to determine the accuracy of the macroscopic examination.

Soil samples were collected from each sample bed and analyzed for pH, phosphorus and potassium.

RESULTS

Ninety-five percent of the 1-year-old seedlings at the Southern Michigan and 85 percent of the 1-year-old seedlings at the Wyman Nursery had some ectomycorrhizal root development (Table 1).

About 25 percent of the seedling feeder roots were classified as ectomycorrhizal at both nurseries the first year and remained unchanged for the next two years (Table 1).

[1/] Twenty seedlings were selected from each age class. If the standard error of the mean was less than ± 10 percent at the 95 percent confidence level, the sampling was discontinued. If the standard error of the mean was more than ± 10 percent at the 95 percent confidence level, additional seedlings were sampled until the accepted percentage was achieved.

The phosphorus (P_2O_5) levels were above 200 lbs/acre in the three-year-old seedling beds at Southern Michigan and in beds of all age classes at Wyman. The potassium levels were above 100 lbs/acre in the two- and three-year-old beds and below 60 lbs/acre in the one-year-old beds at Southern Michigan and in all age classbeds at Wyman. The pH varied from a low of 5.4 to a high of 6.6 (Table 2).

DISCUSSION AND CONCLUSIONS

Increased growth of naturally seeded red pine was correlated with an increase of ectomycorrhizae in the 65-95% range. The 25 percent infection rate in the nurseries is below the desirable level. Also, the 25 percent attained the first year with no increase for the next two years seems to indicate that something is inhibiting the growth of the fungi.

The soils analysis is difficult to relate to the mycorrhizal development. It is speculated that the desirable soil fertility rates for proper ectomycorrhizae development are as follows:

pH	Phosphorus P_2O_5 (lbs/ac)	Potassium (lbs/ac)
5.0-5.5	100-120	150-160

The only beds approaching the desired rate were the 2-year-old seedling beds at the Southern Michigan Nursery. This was the age class that had the best mycorrhizal fungus development.

The fertility rates at the nurseries may be inhibiting mycorrhizal fungus development. We feel that the answer lies in a combination of cultural practices such as fertilization, micro-nutrients, fumigation, pesticide use, watering schedules, seeding dates, cover crops and availability of efficient mycorrhizal fungi.

RECOMMENDATION

When the results are available from the pilot control project on ectomycorrhizae stimulation at the two Lake States Federal Nurseries, the State Nursery managers should consider changes in management to increase ectomycorrhizae development.

RECOMMENDATION FOR RESEARCH

The North Central Forest Experiment Station consider a research project designed to determine the relationship between the many cultural variables and mycorrhizae development in red pine seedlings.

Table 1.--Percentages of red pine ectomycorrhizal feeder roots by seedling age at two State Nurseries, Michigan, 1976

Nursery	Seedling Age (yrs)	Percentage of seedlings with ectomycorrhizae	Percentage of ectomycorrhizal feeder roots
Southern Michigan	1	95	26.5 ± 2.9
	2	100	34.7 ± 1.4
	3	100	27.9 ± 1.2
Wyman	1	85	23.6 ± 1.1
	2	100	21.8 ± 0.7
	3	100	25.9 ± 1.0

Table 2.--Red pine nursery bed soil fertility rates at Southern Michigan and Wyman Nurseries, Michigan, 1976

Nursery	Age (Year)	Phosphorus lbs/acre P_2O_5	Potassium lbs/acre	pH
Southern Michigan	1	137	60	6.6
	2	130	120	5.7
	3	200+	130	5.4
Wyman	1	200+	50	6.4
	2	200+	30	5.5
	3	200+	50	5.5